Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
International Bureau Seeks Comment	)	IB Docket No. 16-185
On Recommendations Approved By	)	
World Radiocommunication Conference	)	
Advisory Committee	)	

To: The International Bureau

COMMENTS OF
THE BOEING COMPANY

The Boeing Company ("Boeing") provides these comments on the 2019 World Radiocommunication Conference ("WRC-19") Advisory Committee ("WAC") recommendations and on the draft proposals from the National Telecommunications and Information Administration ("NTIA") on issues to be considered by WRC-19.[1]

I. EXECUTIVE SUMMARY

Boeing is an active participant in the WAC process of study and development of recommendations for U.S. Proposals to WRC-19. Consistent with these efforts, Boeing urges the Commission to support the following positions:

1. Pursuant to Agenda Item 1.13, adopt View A of the WAC proposals in order to retain the availability of the 48.2-50.2 GHz band for ubiquitously deployed satellite end user terminals operating in the Earth-to-space direction on a paired basis with space-to-Earth downlink transmissions in the 40.0-42.0 GHz band;

[1] *See* Public Notice, *International Bureau Seeks Comment on Recommendations Approved by World Radiocommunication Conference Advisory Committee*, DA 18-1017 (October 3, 2018).

2. Pursuant to Agenda Item 1.6, adopt the consensus WAC proposal for the development of a regulatory framework for non-geostationary satellite orbit ("NGSO") fixed satellite service ("FSS") systems operating in the 37.5-42.5 GHz band (space-to-Earth) and the 47.2-50.2 GHz and 50.4-51.4 GHz bands (Earth-to-space) on a shared basis with geostationary satellite orbit ("GSO") systems;

3. Pursuant to Agenda Item 1.5, adopt View A of the WAC proposals in order to facilitate the reliable operation of earth stations in motion ("ESIMs") communicating with GSO FSS satellites in the 17.7-19.7 GHz and 27.5-29.5 GHz bands;

4. Pursuant to the NTIA proposal on Agenda Item 9, Issue 9.1.9, support further studies within the ITU process on measures to protect passive services in the 52.6-54.25 GHz band from proposed FSS operations in the 51.4-52.4 GHz band; and

5. Pursuant to the NTIA proposal on Agenda Item 9, Issue 9.1.4, support the initiation of studies within the ITU on the integration of suborbital vehicles into air traffic management systems and identification appropriate modifications to the Radio Regulations to support that integration.

The adoption of these recommendations as United States Proposals to WRC-19 would enable the continued growth and operation of high capacity satellite systems to help close the digital divide by making high data rate broadband services available in all locations, including to mobile platforms in flight or at sea, and also to consumers in the most rural and remote portions of the United States and the world. These proposals would also help to ensure continued U.S. leadership in the development of broadband communications and aerospace transport systems. The Commission should therefore present these proposals to the Department of State as the Commission's candidates for United States Proposals to WRC-19 and urge the State Department to submit these proposals to the upcoming meeting of CITEL PCC.II for adoption as Inter-American Proposals for submission to WRC-19.

II. THE UNITED STATES POSITION ON AGENDA ITEM 1.13 MUST ENSURE THAT FREQUENCY RESOURCES REMAIN AVAILABLE IN THE V-BAND FOR THE OPERATION OF BROADBAND SATELLITE SYSTEMS TO HELP CLOSE THE GLOBAL DIGITAL DIVIDE

Boeing acknowledges the Commission's goal of ensuring that, pursuant to Agenda Item 1.13, sufficient spectrum resources are made available in millimeter wave ("mmW") frequency bands for the future development of International Mobile Telecommunications ("IMT"), which the Commission has designated as the Upper Microwave Flexible Use Service ("UMFUS"). UMFUS networks will provide very high capacity terrestrial broadband services in highly populated and dense urban areas where mobile wireless spectrum in lower frequency bands may be congested.

At the same time, the Commission has a statutory public interest obligation to ensure that broadband communications services are made available to rural and remote areas of the United States to facilitate digital learning, healthcare, commerce and internet services for all Americans. In this regard, some have argued that UMFUS networks may eventually reach less populated areas of the country. Thus far, however, the only broadband delivery technology that has demonstrated the capability to provide high data rate broadband services to all locations of the country is satellites. The President's National Space Council recognized the importance of this goal, recommending in its February 2018 report that the NTIA and the Commission coordinate to ensure the protection and stewardship of the spectrum necessary for commercial space activities.[2]

[2] *See* https://spacepolicyonline.com/wp-content/uploads/2018/02/WH-press-release-NSpC-Recs-Feb-21-2018.pdf (Recommendation 3). *See also* comments of Earl Comstock, director of the Office of Policy and Strategic Planning at the Commerce Department: "There is a concern within the administration" about protecting satellite applications even while trying to also facilitate 5G services. We don't want to discover that we've stunted the growth of that market by denying them spectrum that might be needed." Quoted in Space News, May 1, 2018, at http://spacenews.com/space-council-seeking-to-protect-satellite-spectrum/.

Therefore, it is imperative that the United States delegation to WRC-19 work aggressively to preserve adequate frequency resources in the V-band for the operation of ubiquitously deployed satellite end user terminals. Consistent with this, NTIA's proposals for WRC-19 also supports the preservation of the 48.2-50.2 GHz band for FSS networks.

Unfettered access to the 48.2-50.2 GHz band is necessary for Earth-to-space communications by satellite end user terminals paired with the 40.0-42.0 GHz band for space-to-Earth communications. These frequencies cannot be shared between satellite end user terminals and IMT unless severe restrictions are placed on the placement of both types of systems to ensure adequate physical separation. View B suggests that terrestrial IMT will not cause harmful interference to satellite receive terminals in space, but these conclusions are based on assumptions regarding IMT density and operations that, absent adequate regulatory restrictions, may not be reflected in practice. Proponents of View B strongly oppose the adoption of such regulatory restrictions on IMT. Further, View B completely fails to acknowledge that ubiquitously deployed satellite earth station transmitters would likely cause significant interference to UMFUS receivers, which is the primary reason why their ubiquitous operations must be segregated into different frequency bands.

In advocating for the preservation of the 48.2-50.2 GHz band for broadband satellite services, Boeing acknowledges the claim of proponents of View B that the actual portion of the 47.2-50.2 GHz band that is reserved for satellite terminal uplink communications may vary in different regions of the world, with a different portion of the V-band being made available for satellite uplinks in Region 3. Although such lack of harmonization is undesirable, under no circumstances would it justify a U.S. position that fails to identify any portion of the V-band as available for the unfettered operation of ubiquitously deployed satellite end user terminals.

Further, in identifying which portion of the V-band should be made available for satellite end user terminals, it would obviously be appropriate for the U.S. to advocate in favor of an international allocation (or, at least, an allocation for Region 2) that matches the Commission's determination in its Spectrum Frontier's proceeding that the 48.2-50.2 GHz band is the most appropriate spectrum available for the operation of ubiquitously deployed satellite end user terminals. Accordingly, the U.S. position to WRC-19 should be that no changes be made to the Radio Regulations with respect to the identification of the 48.2-50.2 GHz band in ITU-R Region 2 for high density FSS applications.

III. THE COMMISSION SHOULD SUPPORT THE ADOPTION OF A REGULATORY FRAMEWORK FOR SHARING BETWEEN NGSO AND GSO FSS SYSTEMS OPERATING IN THE 50/40 GHZ BAND AND THE PROTECTION OF THE EARTH EXPLORATION SATELLITE SERVICE IN FURTHERANCE OF AGENDA ITEM 1.6

Boeing is strongly committed to the development and operation of both GSO and NGSO satellite systems operating on a co-frequency basis throughout the 37.5-42.5 GHz band (space-to-Earth) and the 47.2-50.2 GHz and 50.4-51.4 GHz bands (Earth-to-space) (hereinafter "50/40 GHz bands"). As the Commission has acknowledged, NGSO and GSO systems can share spectrum resources using GSO arc avoidance techniques.[3] In fact, the use of GSO arc avoidance by NGSO licensees is necessary to enable GSO operations in shared spectrum bands.[4]

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[3] *See* Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters, *Report and Order and Further Notice of Proposed Rulemaking*, 32 FCC Rcd 7809, ¶ 39 (2017) (observing that "[g]enerally, both GSO networks and NGSO FSS systems can operate using the same frequencies if NGSO systems are required to protect GSO networks"). GSO arc avoidance is achieved when the NGSO satellites inhibit their transmissions within a "GSO protection zone" that is centered on the equator relative to the sub-satellite orbital path.

[4] *See id.* (observing that "[i]f NGSO systems are not required to protect GSO networks, GSO networks may be precluded entirely, because as a general matter they have less flexibility to avoid causing harmful interference to NGSO systems or protecting themselves . . .").

A. The Commission Should Support the WAC Proposal as the U.S. Position to WRC-19 with Respect to the Adoption of a Regulatory Regime for Sharing Between NGSO and GSO FSS Systems

Agenda Item 1.6 seeks the development of a regulatory framework, including technical provisions, to govern the sharing between NGSO satellite systems and GSO networks in the 50/40 GHz bands. As a major manufacturer of both NGSO and GSO satellite networks in the United States, Boeing is committed to ensuring the success of both types of next generation satellite technologies and ensuring the protection of both planned and operating FSS systems. Boeing also believes that an appropriate sharing regime for the 50/40 GHz band should be less burdensome on NGSO licensees than the very stringent rules that were adopted for NGSO/GSO sharing in the Ku- and Ka-bands, while providing the same or higher levels of protection for GSO FSS operations.

Boeing has been active in the ITU-R study process in developing technical studies and participating in discussions to develop a regulatory approach to facilitate sharing between NGSO systems, while ensuring protection of GSO satellite networks in the 50/40 GHz frequencies. The consensus WAC proposal for Agenda Item 1.6 reflects the results of ITU-R sharing studies and compromise discussions within the FCC's Informal Working Groups among the FSS stakeholder community. In particular, this proposal identifies a methodology to allow for additional flexibility in the design and operation of NGSO systems, leading to maximum spectral efficiency for NGSO FSS systems while fully protecting the operation of co-frequency GSO networks. This proposal will shape spectrum use of these bands to allow for maximum design flexibility, increased capacity, faster development time, and less design costs for next generation satellite systems in the 50/40 GHz frequency bands. Boeing notes that the NTIA proposal supports a similar methodology to address issues of sharing between NGSO and GSO systems based on Method A of the report of the Conference Preparatory Meeting ("draft CPM Report") under Agenda Item 1.6.

Additionally, this proposal presents a regulatory solution to ensure and monitor the aggregate effects to ensure that operating NGSO FSS systems do not exceed the aggregate protection requirements of GSO networks. The inability to monitor the aggregate effects of NGSO FSS systems is an issue that has been identified as one possible deficiency in regulatory sharing provisions addressing NGSO and GSO FSS operations in frequency bands below 30 GHz. This consensus proposal provides a regulatory solution that addresses the need to track the contribution to the aggregate emission level of each NGSO system in operation, foster the ability to conduct technical consultations to calculate and observe the aggregate effects of multiple NGSO systems, and provides regulatory requirements for actions to be taken if the aggregate effects of NGSO operations exceed the GSO protection requirements.

The procedure proposed to monitor the aggregate effects of NGSO systems by means of this proposal allows for a regulatory regime that can account for the actual operating environment of all operating NGSO systems and provides for additional GSO FSS system protections due to the knowledge of the actual operating environment in the 50/40 GHz bands. This ability to monitor aggregate effects of NGSO operations and the identification of regulatory actions to be taken to prevent exceedance of the aggregate limit provides guaranteed protection to GSO operations. Therefore, the Commission should support the adoption of the consensus proposal as the formal U.S. position to WRC-19.

Four methods are identified in the draft CPM Report as a potential solution for WRC-19 Agenda Item 1.6. All four methods propose a similar approach to address issues related to NGSO and GSO sharing. The WAC proposal is based upon a version of Method A in the draft CPM Report, with some modifications based on stakeholder discussions between Viasat and Inmarsat. In particular, consensus modifications were made based on discussions with Viasat in the draft

Resolution of the proposal to provide protection to adaptive coding and modulation systems from aggregate interference from multiple NGSO systems. Modifications were also made regarding additional protections for mobile satellite service ("MSS") operations in 39.5-40 GHz and 40-40.5 GHz bands.

In contrast, the proposal from the NTIA is based on Method D of the draft CPM Report. Method D (and the NTIA proposal) use the same concepts that were employed in Method A for sharing between GSO and NGSO FSS systems, but lack the improvements that resulted from the compromise discussions that have been held between FSS stakeholders in the United States. Boeing therefore urges the Commission to impress upon NTIA the need for the U.S. Position to WRC-19 to reflect the compromise agreements that are included in the WAC proposal regarding the protection of GSO FSS and MSS systems from the aggregate interference of multiple NGSO system operations.

B. The Commission Should Support the Ongoing Work Within the Existing Study Cycle Intended to Identify Less Burdensome Means for FSS Networks to Protect EESS Sensors in the 50.2-50.4 GHz Band

The WAC proposals for Agenda Item 1.6 also address methods for protecting Earth Exploration-Satellite Service ("EESS") systems operating in the adjacent 50.2-50.4 GHz band. Studies in the ITU-R process have shown that the operation of FSS systems in the 48.2-50.2 GHz and in the 50.4-51.4 GHz band may exceed the protection criteria for EESS systems in the adjacent 50.2-50.4 GHz band. New protection limits therefore may be needed in the Radio Regulations to ensure that emissions from GSO and NGSO satellite systems do not interfere with EESS systems operating in the 50.2-50.4 GHz band.

The protection limits that are included in the NTIA proposal, however, would have a devastating impact on FSS systems seeking to operate just above or below the EESS allocation at

50.2-50.4 GHz because they would relegate as unusable significant portions of the upper end of the 48.2-50.2 GHz and the lower end of the 50.4-51.4 GHz bands, both of which are critical for FSS uplink communications. Therefore, the Commission should encourage the U.S. government to support the ongoing work that continues within the existing ITU study cycle on adequate measures to protect EESS systems in the 50.2-50.4 GHz band from emissions from FSS systems operating in the 50/40 GHz bands.

In supporting the completion of further analysis in the existing study cycle, Boeing believes that mitigation measures and operational considerations can be rapidly identified involving the use of orbital and frequency avoidance techniques for FSS networks that could protect valuable EESS sensors and also allow for continued use of the FSS allocations that are immediately adjacent to the 50.2-50.4 GHz band. Such orbital and frequency avoidance techniques have been identified as effective in enabling sharing between co-frequency GSO and NGSO systems and further work is likely to reveal that they can also be used to protect EESS systems in adjacent frequencies.

Prior studies on the protection levels needed for EESS sensors have considered only the use of filtering to protect these passive sensors, which have proven burdensome and inadequate to permit the efficient use of the FSS allocations at 48.2-50.2 and 50.4-51.4 GHz. The Commission therefore should support the WAC proposal on the adoption of a regulatory framework for NGSO/GSO sharing in the 50/40 GHz band and encourage NTIA to hold in reserve its proposed EESS protection limits while further measures are identified in the current study cycle to ensure the protection of passive receivers in the 50.2-50.4 GHz band.

IV. THE COMMISSION SHOULD SUPPORT VIEW A WITH RESPECT TO ADOPTING REGULATORY MEASURES FOR THE OPERATION OF EARTH STATIONS IN MOTION ("ESIMS") COMMUNICATING WITH GSO FSS SATELLITES IN THE 17.7-19.7 GHZ AND 27.5-29.5 GHZ BANDS PURSUANT TO AGENDA ITEM 1.5

For nearly three decades, arguably beginning in 1989, the Commission has authorized the use of satellite earth stations affixed to mobile platforms to communicate with FSS networks.[5] As the satellite industry and the Commission gained more experience with mobile earth stations operating with FSS networks, the Commission formalized its rules for such services, adopting rules for earth stations on vessels ("ESV") in 2005,[6] earth stations operating on vehicles ("VMES") in 2009,[7] earth stations aboard aircraft ("ESAA") in 2012,[8] and finally consolidated rules for all FSS earth stations in motion ("ESIMs") just a few weeks ago.[9]

Throughout all of these proceedings, the Commission has recognized that ESIMs can provide very high data rate broadband communications, navigation, situational awareness and

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[5] *See Qualcomm, Inc.*, 4 FCC Rcd 1543 (1989) (authorizing the use of low data rate transceivers on trucks and other vehicles to communicate with FSS networks in the Ku-band).

[6] Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands, IB Docket No. 02-10, *Notice of Proposed Rulemaking*, FCC 03-286, 18 FCC Rcd 25248 (2003).

[7] *See* Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service, IB Docket No. 07-101, *Report and Order*, FCC 09-64, 24 FCC Rcd 10414 (2009).

[8] *See* Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands, IB Docket No. 12-376, *Report and Order*, FCC 12-161 (Dec. 28, 2012).

[9] *See* Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service, IB Docket 17-95, *Report and Order and Further Notice of Proposed Rulemaking*, FCC 18-138 (Sept. 27, 2018).

safety services to mobile platforms that often cannot be served using other communications technologies. ESIMs provide essential support services to ships at sea, aircraft in domestic and transoceanic flight, and motor vehicles in uninhibited terrain, in each case supporting commercial ventures (such as remote energy extraction), homeland security (such as Air Force drone flights in the Arabian Sea), and humanitarian efforts (such as rescue efforts following major hurricanes).

Throughout its rulemaking proceedings, the Commission has also recognized that ESIMs can operate successfully with FSS networks because they employ technologies that ensure that ESIMs do not cause any more interference to other spectrum users (be they neighboring FSS networks or other technologies) than what the Commission has previously authorized for FSS earth stations operating at fixed locations. The interference characteristics of FSS networks that communicate with ESIMs are therefore effectively indistinguishable from FSS networks that communicate solely with earth stations at fixed locations.

Given this background, the Commission should disregard the continued claims by Iridium that further studies are needed to document that ESIMs can share spectrum successfully with other services, including the feeder links for Iridium's NGSO MSS network. Although mobile, ESIMs can comply with coordination agreements between GSO FSS and NGSO MSS networks, including those that include geographic exclusion zones around NGSO MSS feeder link earth stations.

On a related issue, no valid reason exists for the U.S. delegation to WRC-19 to refrain from supporting the inclusion in the Radio Regulations of specific transmission limits for ESIMs operating with GSO FSS networks in the 17.7-19.7 GHz and 27.5-29.5 GHz bands to ensure the adequate protection of terrestrial services that may operate in portions of these frequencies. View A supports the adoption of interference limits for ESIM operators that will provide clear notice

and regulatory certainty both for FSS network operators employing ESIMs and also for terrestrial network operators that are planning to use portions of this same spectrum.

In contrast, View B would abdicate the ITU's global mission of promoting harmonization in spectrum use and regulation by refraining from adopting in the Radio Regulations clear limits on ESIM emissions in the 17.7-19.7 GHz and 27.5-29.5 GHz bands that would produce the regulatory certainty that is necessary for continued investment and growth in both 5G terrestrial networks and global satellite communications systems equipped with ESIM capabilities. The global leadership of the United States in terrestrial and satellite communications technologies has always benefited most by the adoption of harmonized international regulatory standards that allow the mass production and export of U.S.-developed technologies on a global scale. The United States delegation to WRC-19 should adhere to this fundamental principle of economic development and growth by supporting the adoption of regulatory provisions governing the operation of ESIMs with GSO FSS networks in the 17.7-19.7 GHz and 27.5-29.5 GHz bands.

V. THE COMMISSION SHOULD SUPPORT THE CONSIDERATION OF APPROPRIATE PROTECTION LEVELS TO PROTECT EESS SENSORS IN THE 52.6-54.25 GHZ BANDS FROM FSS OPERATIONS AT 51.4-52.4 GHZ

WRC-19 Agenda Item 9, Issue 9.1.9, calls for studies on whether FSS networks require access to the 51.4-52.4 GHz band. As the Commission will recall, Boeing filed a petition for rulemaking in 2016 highlighting the significant need for a co-primary allocation for FSS in the 51.4-52.4 GHz band, which is adjacent to the co-primary FSS allocation that already exists in the 50.4-51.4 GHz band.[10]

[10] *See* Petition of The Boeing Company for Allocation and Authorization of Additional Spectrum for the Fixed-Satellite Service in the 50.4-51.4 GHz and 51.4-52.4 GHz Bands, RM-11773, at 5-9 (June 22, 2016).

Boeing's petition focused primarily on the needs of NGSO FSS systems for access to the 51.4-52.4 GHz band, while Boeing acknowledges that Issue 9.1.9 focuses solely on GSO FSS systems. Nevertheless, the spectrum sharing capabilities between NGSO and GSO FSS systems discussed in earlier sections of these comments are eroding the need for separate consideration of spectrum access for NGSO and GSO systems. Boeing therefore supports the identification of the 51.4-52.4 GHz band as necessary and available for GSO FSS systems as a precursor to similar action with respect to access to these frequencies for NGSO FSS systems. To this end, Boeing has participated in the development of the spectrum needs report under this agenda item, which has identified that there is a need for the identification of the 51.4-52.4 GHz bands for FSS.

ITU-R working groups have conducted sharing studies that have shown that coexistence between FSS and incumbent active services can be achieved in the 51.4-52.4 GHz band. The NTIA proposal, however, seeks a No Change for this agenda item based on the need to identify methods to protect passive services in the nearly adjacent 52.6-54.25 GHz band. Studies have been conducted within the ITU-R on the options available to facilitate the protection of EESS systems operating in various portions of the V-band, including the bands 51.4-52.4 GHz. Pending identification of an appropriate means to adequately protect EESS sensors from FSS operations in the 51.4-52.4 GHz bands based on studies within the ITU-R, Boeing urges the Commission to support a U.S. Position on Issue 9.1.9 that calls for further studies on the identification of operational and technical measures that can be employed to protect EESS sensors operating in the 52.6-54.25 GHz band from FSS systems operating in the 51.4-52.4 GHz bands. Such studies are necessary to ensure the efficient use of V-band spectrum to support next generation FSS networks that are being designed to provide very high data rate broadband services to users in rural and remote areas of the United States and the world.

VI. THE COMMISSION SHOULD SUPPORT THE NTIA PROPOSAL FOR AGENDA ITEM 9, ISSUE 9.1.4 WITH RESPECT TO THE IDENTIFICATION OF REGULATORY MEASURES TO FACILITY THE OPERATION OF SUBORBITAL VEHICLES

Boeing researchers and engineers are active in the development of suborbital vehicles that could revolutionize access to low Earth orbit and intercontinental transportation. For example, Boeing is collaborating with the U.S. Defense Advanced Research Projects Agency ("DARPA") to design, build and test a technology demonstration vehicle for the agency's Experimental Spaceplane program. The spaceplane—called Phantom Express—would reinvent space missions for commercial and government customers by providing rapid, aircraft-like access to space. Within minutes, the autonomous, reusable spaceplane would launch its upper stage to deploy small satellites into low Earth orbit. It would then land on a runway to be prepared for its next flight.

In support of such activities, Agenda Item 9, Issue 9.1.4 seeks the study of regulatory measures that will be needed to address the technical and operational measures regarding communications systems on-board suborbital vehicles, including operational and communications payload systems. One focus of these studies should be the integration of suborbital vehicles into the air traffic management systems that already exist for the safe and efficient operation of aircraft and aerospace vehicles and the identification of appropriate modifications to the Radio Regulations to support that integration. Boeing has participated in studies on this agenda item and agrees with the NTIA that further consideration is appropriate regarding the definition of suborbital vehicles

and the identification of technical and operational measures that may be needed to ensure the safe and efficient operation of these future flight systems.

Respectfully submitted,

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